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Maurotarion mystax (see note on page 2)

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CONTENTS

FRONT COVER: Maurotarion mystax Holloway and Sandford, 1993, from the Early Silurian (Late Llandovery) Richea Siltstone, Tiger Range, south-west Tasmania. Photograph of holotype, Museum of Victoria specimen P137206, x 5, courtesy of Dr D. Holloway. [Reference: An Early Silurian trilobite fauna from Tasmania. Memoir 15 of the Association of Australasian Palaeontologists: pp. 85-102.]

EDITORIAL NOTES

DEADLINE FOR THE NEXT ISSUE

Material for the next issue should be submitted by 20th April, 1994, unless otherwise arranged with the Editor. As always articles and extracts are urgently needed.

SUBSCRIPTIONS

Subscriptions for the 1994/95 financial year are due on 1st March (renewal form enclosed). Payment before the end of April would be appreciated to avoid the expense of sending out reminder notices. As reserves are still adequate for our needs and as as far as we can ascertain there are unlikely to be any major increases in postal or printing costs, annual subscriptions will remain unchanged, namely:-

Surface Mail:	Australia, New Zealand, Papua/New Guinea	$ 7.50
	All other countries	$ 9.00
Air Mail:	New Zealand, Papua/New Guinea	$ 10.00
	East Asia	$ 12.00
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(All subscriptions are quoted in Australian dollars)

PROTECTION OF MOVABLE CULTURAL HERITAGE REGULATIONS (AMENDMENT). Statutory Rules 1993 No. 215 (Notified in the Commonwealth of Australia Gazette on 3 August, 1993).

In the above amendment to the regulations, the $1,000 valuation limit on palaeontological objects has been removed so that all fossils, irrespective of value, are now subject to the Regulations and require the issue of a permit before they can be exported from Australia. The only other amendment to the Protection of Movable Heritage Act 1986, Part V - Natural Science Objects of Australian Origin, relates to the definition of holotype, which in the case of palaeontological objects, extinct flora and fauna, and minerals, has been expanded to include lectotype, neotype, paratype and syntype.

Members wishing to export fossils for whatever reason (gift, exchange or sale etc.) should write to the Heritage Protection Section, Department of Arts and Administrative Services, GPO Box 1920, Canberra, ACT 2601 or phone (06) 274 1111, requesting an 'Application for an Export Permit'. This form requires, as well as normal applicant details, the following questions to be answered about the fossils to be exported:- what is it, what size is it, what age is it, when and where was it found, who found it, what is its current market value in AUS$, details of any publication in which it has been listed or photographed, does it have any distinguishing marks, and any other information including rarity or importance - if known.

In addition, the applicant is required to provide photographic evidence as follows:- for single objects, a photograph, either in black-and-white or colour (a snapshot, provided the object is clearly visible and identifiable, or a clear photocopy of a photograph of the object(s) published in a book or catalogue may be adequate); for collections, one photographic print of the most rare or significant examples is sufficient. Large collections are likely to be inspected. Further details are required concerning the reason for the export, whether permanent or temporary.

Although a request was made to the National Cultural Heritage Committee to be kept informed of any changes to the Act (FCAA letter, 22 February, 1993), we were only advised that the above amendment was to be considered. Consequently it was not

PROTECTION OF MOVABLE CULTURAL HERITAGE REGULATIONS (Cont.)

possible to print this information in Bulletin 41 - in fact we only found out about the change because of the Editor's association with the Museum of Victoria.

While this amendment will make the export of fossils an arduous and time consuming process, members wishing to continue exchanging with overseas collectors should not be put off, as provided the Australian material being exchanged is not rare and has been fully described in a scientific publication, it would seem unlikely that a permit would be refused.

Full details of the Act and previous amendments were published in Bulletin No. 36, January, 1992, pp. 6-10.

WANTED: PUBLICATIONS ON THE DEVONIAN OF AUSTRALIA

Alan Goldstein, Naturalist (Paleontologist), who is responsible for the collections and resource library at the new "Falls of the Ohio State Park" in Indiana (opened January 25th, 1994), would welcome the donation of any publications on the Devonian of Australia for the Park's reference library. Anyone who can assist should send material to Alan, C/o. **Division of State Parks, Falls of the Ohio State Park, 201 W. Riverside Drive, Clarkville, Indiana 47129, U.S.A.**

OVERSEAS COLLECTORS WISHING TO EXCHANGE FOSSILS

John Fam, 4052 Uplands Drive, Nanaimo, Vancouver Island, B.C. V9T-4H1, Canada, is interested in finding out about Australian fossils, especially ammonites, crabs, fruits and seeds. Has similar Canadian material for exchange.

Henk van Noordenburg, Schaapherder 16, 3834 CK Leusden, Netherlands, would like to acquire Australian echinoids in particular regular and marsupiate specimens (both male and female). Has a range of over 40 European echinoid species to exchange.

IN THE NEWS

FOSSIL TRAFFICKERS FACE PRISON SENTENCES

The owner of the most complete skeleton of a Tyrannosaurus rex has been charged with taking fossils illegally from US government land. But the company concerned, the Black Hills Institute of Geological Research, says it is innocent.

The company, four of its employees and four other individuals were formally charged late last month. The indictment does not specifically mention "Sue", the T. rex skeleton that hit the headlines last year after it was seized by the FBI. The government impounded the skeleton in 1992 during its investigation into the company's practices (see Bulletin 37, p.20). The dinosaur was unearthed on Indian land in the Black Hills region of South Dakota in 1990.

The indictment accuses the company of trafficking illegally in a variety of other fossils; including remains of the dinosaurs (Triceratops, Edmontosaurus), and fossil catfish, sharks and turtles. According to the charges, the bones were taken from Indian reservations as well as government property.

A date has not yet been set for the trial. Each of the 39 counts in the indictment carries a potential penalty of 10 years in jail and a fine of US$250,000.

Report in **New Scientist**, 4th December, 1993.

PETRIFIED (PERMINERALIZED) WOOD IN WESTERN AUSTRALIA

Stephen McLoughlin and Marisa Worth, Dept. of Geology and Geophysics, University of Western Australia, Nedlands, W. A. 6009.

Abstract

The distribution, botanical affinities, process of permineralization, and palaeoclimatic significance of Western Australian petrified woods is discussed.

Introduction

Western Australia has fossil wood of various ages. Fossil wood is even more common in eastern Australia and museum curators and university researchers probably receive more enquiries about, and donations of, petrified wood than virtually any other category of fossils. Fossil wood can yield valuable information about ancient climates through growth ring studies, and the growing trade in petrified wood has seen large (1 m) diameter polished slabs fetching 5 figure sums in North America. Despite this, the study of fossil wood has been much neglected in Australia. To date, most research has been essentially descriptive with just a few palaeoclimatic studies of southern and eastern Australian Cretaceous and Quaternary woods. The Late Permian, Early Cretaceous, and Eocene all appear to offer great potential for Australia wide palaeoclimatic analysis owing to widespread occurrences of woods of these ages.

Location and age of Western Australian fossil woods

The oldest significant petrified wood in Western Australia occurs in the Late Permian Condren Sandstone near Christmas Creek, southeast of Fitzroy Crossing (Fig. 1). Some poorly preserved Early Permian wood also occurs in the Minilya River area of the Carnarvon Basin.

Early to Middle Jurassic wood occurs in various rock units in the northern Perth Basin especially in the Jurien Bay and Moonyoonooka areas. However, much of this wood is rather fragmentary or poorly preserved. Furthermore, much of the wood from the Jurien district is protected within national reserves.

Early Cretaceous fossil wood is abundantly represented in exposures of the Birdrong Sandstone, Yarraloola Conglomerate, and Nanutarra Formation in the Kalbarri and Ashburton Fortescue districts of the Carnarvon Basin. Scarce fossil wood also occurs in the Dandaragan Sandstone near Gingin and Dandaragan.

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

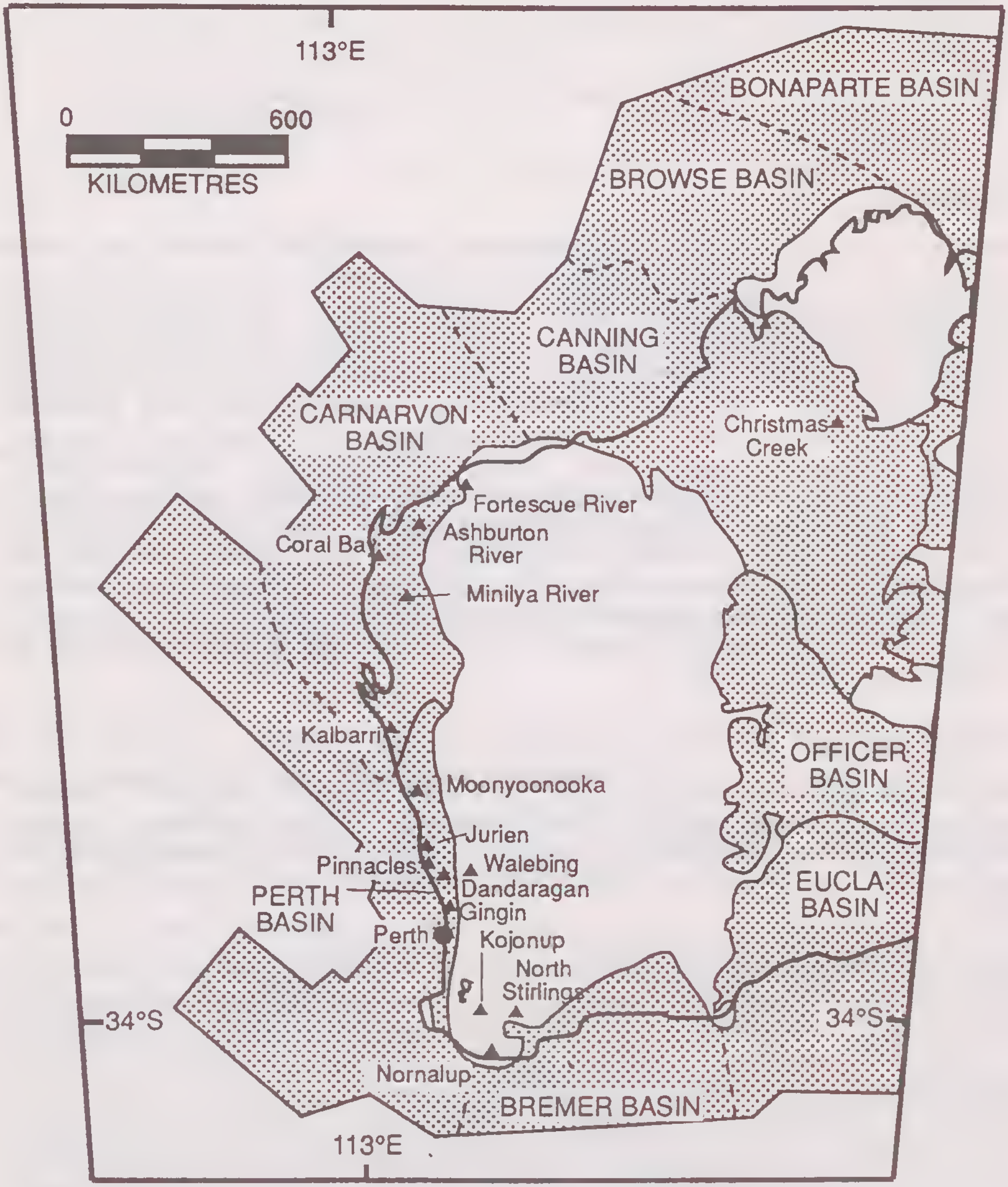

Fig. 1. Map of Western Australia showing principal fossil wood localities.

Eocene fossil woods and roots occur in isolated swamp and lake sediments north of the Stirling Ranges in the state's southwest and in the Kennedy Ranges, Carnarvon Basin. The Western Australian Museum also holds small collections of Tertiary woods from various other sites including, Kojonup, Walebing, Robe River, Northcliffe, and Nornalup.

Parent plants

Petrification is not confined to any particular plant group as organisms ranging from fungi to angiosperms, and even animals, can become permineralized given the appropriate conditions. Western Australia's Permian petrified logs are up to 40 cm. in diameter and probably derive from the dominant plants of that time - the glossopterids. However, the Canning Basin woods display some unusual anatomical features including large vessel-like tubes similar to angiosperms. These woods will be the focus of a research project over the next three years.

The Western Australian Jurassic and Cretaceous woods have anatomies characteristic of podocarpacean and araucarian conifers, the foliage of which are preserved in correlative terrestrial strata (McLoughlin & Guppy, 1993a).

The little-studied Eocene woods clearly include both conifers and angiosperms. The conifers probably belong to the Araucariaceae (bunya-pine family), Podocarpaceae (plum-pine family), or Cupressaceae (cypress family) as leaves of these groups occur in nearby Eocene deposits at Kojonup (McLoughlin & Guppy, 1993b). The angiosperm woods are distinguished by prominent water-conducting vessels within the wood. Some resemble modern she-oaks (Casuarinaceae) but others may have affinities to the Proteaceae, Fagaceae, Myrtaceae or other families which were abundant at that time (McLoughlin & Guppy, 1993b). Churchill (1973) also considered some of this wood to be comparable to Barringtonia (Lecythidaceae).

The process of petrifaction

Animals and plants can be fossilised by several quite different processes. Impressions, or moulds, are cavities left behind in the sediment after the original organic matter has been leached away. External moulds are produced by cementation of sediment around the specimen preserving a negative surface image but yielding no internal anatomical details. Internal moulds are impressions of cavity surfaces within animals or plants. Duripartic preservation involves preservation of the original hard parts of organisms,

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

such as shells, bone and teeth and includes animal hard parts which have been recrystallised (Schopf, 1975). Casts represent bulk replacements of organic soft or hard parts by new mineral matter or sediment. They show a positive image of the original organism but do not yield internal anatomical details.

Petrifaction (cellular permineralization) is a more specialised preservational style involving the precipitation of minerals in the interstices of organic tissues, but not replacement of the original organic material. Schopf (1975) noted that organic matter is retained in most petrified woods, although it is sometimes lost during later stages of alteration or weathering. Hence, petrifaction is not a case of molecule by molecule replacement of organic carbon by inorganic material. Rather, it is a case of the early infiltration of mineral-charged water into the plant tissue and its permeation into intracellular and interstitial tissue voids.

Precipitation of microcrystalline minerals then impregnates, coats, and in-fills cavities within the tissues, preserving the original organic matter. The physical conditions favouring plant petrifaction appear to be: a) sediment with good porosity (allowing the movement of mineral-rich groundwaters; b) slightly acid conditions; and c) anaerobic conditions (Scurfield, 1979). Petrified woods are common in ancient riverine sands and gravels and in sandy sediments of continental shelves. Petrifaction is especially common within volcanic ash deposits or where fluvial sediments are derived from volcanic terraines. Rapid decomposition of volcanic glass and other unstable minerals provides a rich silica source for petrifaction (Jefferson, 1987).

Silica is by far the major constituent of petrified wood. Schopf (1975), Scurfield (1979) and Jefferson (1987) indicated that silica impregnates the cell walls first, forming chalcedony and/or quartz. Opaline silica, goethite, haematite, siderite and pyrite are also commonly reported from petrified woods but calcite, aragonite, galena, sulfur, and apatite may also be present. Western Australian Cretaceous woods occur in glauconitic marine sediments where both apatite (calcium phosphate) and silicates are the dominant petrifying agents.

Another interesting form of plant fossilisation occurs in Western Australia (and at various other locations along the Australian coast, such as Portland, Victoria). The Nambung National Park

near Cervantes is famous for an area of exhumed calcareous pillars known as "The Pinnacles". The pinnacles represent solution pipes, rhizoliths, or rhizoconcretions in Pleistocene aeolian calcareous sand (McNamara, 1983) and are largely the result of plant root activity providing a passage for water percolation into the soil. The zone around the root is usually more acidic and this increases the rate of dissolution and mobility of the calcareous component of the soil. The combination of the downward movement of mineral-bearing waters and changes in the groundwater chemistry at certain levels in the soil profile has resulted in the re-precipitation of minerals in and around the root cavity at depth. Thus the pinnacles are essentially root casts and coatings and are not strictly "petrified" in the formal sense.

The uses of fossil wood

Growth banding evident in fossil woods (Fig.2) enable interpretation of past climatic conditions by comparing them to the ring development in modern trees from different climatic belts (Chaloner & Creber, 1973; Fritts, 1976). A number of environmental factors may influence the production of growth rings in a plant's woody tissues but the most important are moisture, temperature and light which are strongly seasonal parameters at high latitudes (Fritts, 1976; Creber & Chaloner, 1984). Ideally, palaeoclimatic interpretations for an area should be based on fossilised upright tree stumps of the same species positioned in relatively close proximity

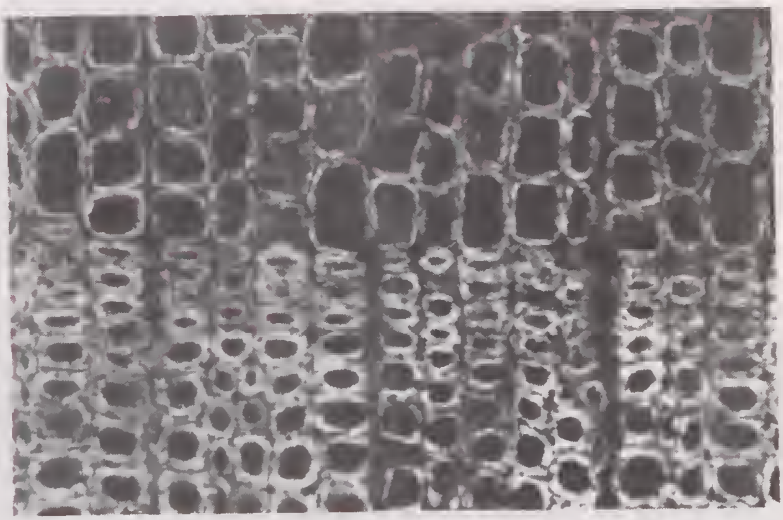

Fig. 2. Transverse thin section of Cretaceous conifer wood showing the variation in cell diameter from late season wood to early season wood (x 300).

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

Fig. 3. Transverse section of Cretaceous conifer wood showing fungal degraded pockets (x 3).

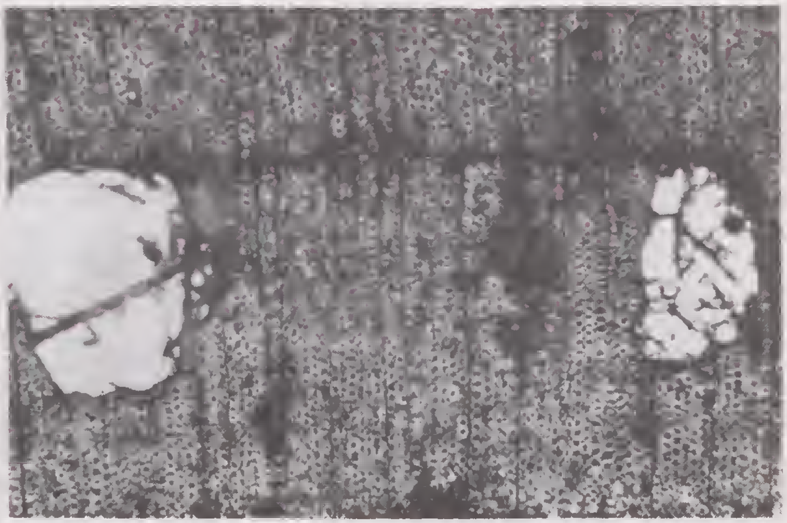

Fig. 4. Magnification of degraded Cretaceous wood showing fungal filaments in cavities (x60).

so that many of the competing environmental factors will apply to all specimens. Most fossilised woods have been transported to some degree but can still provide important general information about climatic parameters provided a large enough collection of samples (minimum of 30-50 logs) is studied.

Several qualitative and quantitative measures have been established for analysing growth bands in assessing palaeoclimate. Qualitative considerations include the recognition of growth rings and their degree of prominence within the wood. Quantitative analysis includes measurement of growth ring widths, cell proportions of early and late season wood production, variation in cell size between early and late wood, the number of cells produced per season, and several measures of ring width variation between seasons. **Annual sensitivity** is a measure of the difference in width between a pair of consecutive growth bands divided by their average width (Creber, 1977). **Mean sensitivity** (Fritts, 1976) is a measure of the average of these values for each tree and provides an indication of the plant's growth response to variable climatic factors. It probably offers the most valuable information about past climatic conditions and is calculated using the following formula :

$$\text{mean sensitivity} = 1/n\text{-}1 \sum |2(X_{t+1}-X_t)/X_{t+1}+X_t|$$

where X = ring width, t = year number of ring, n = number of rings in sequence.

In most cases the environmental factors which influence growth ring production are moisture, temperature, and light. Modern trees have mean sensitivities ranging from 0 to 1.0. Trees having a mean sensitivity of <0.3 are considered 'complacent' and typically grow under relatively uniform climates. Those having mean sensitivities >0.3 are regarded as 'sensitive' and grow under more variable climatic conditions from season to season.

Other information is sometimes available from fossil wood. Some woods contain evidence of insect borer activity (Scott, 1991). The Cretaceous woods from Western Australia were mostly deposited within marine environments and have been intensely bored by marine bivalves (shipworms) of the families Teredinidae or Pholadidae although the animals' shells have not been preserved. The Coral Bay woods have also revealed the first evidence of wood-decaying fungi from the Australian Cretaceous in the form of delicate hyphae occupying wood cavities similar to the texture produced by modern pocket-rot fungi (Figs. 3-4). Where upright fossil stumps are

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

preserved they can also reveal the spacing of plants in ancient forest communities which may in turn have been a response to nutrient and light availability.

Features of the Western Australian fossil woods

The growth characteristics of 48 Early Cretaceous conifer wood specimens from the Birdrong Sandstone in the Coral Bay area were recently examined. The woods range from 2.2 to 17 cm in diameter and show between 5 and 117 distinctive growth bands. Growth ring width vary from 0.033 mm. to 12.340 mm. with averages for individual axes in the range 0.177-9.39 mm. Some woods show relatively little interseasonal variability (Figs. 5A,B) whereas others show marked inter-yearly fluctuations in wood production

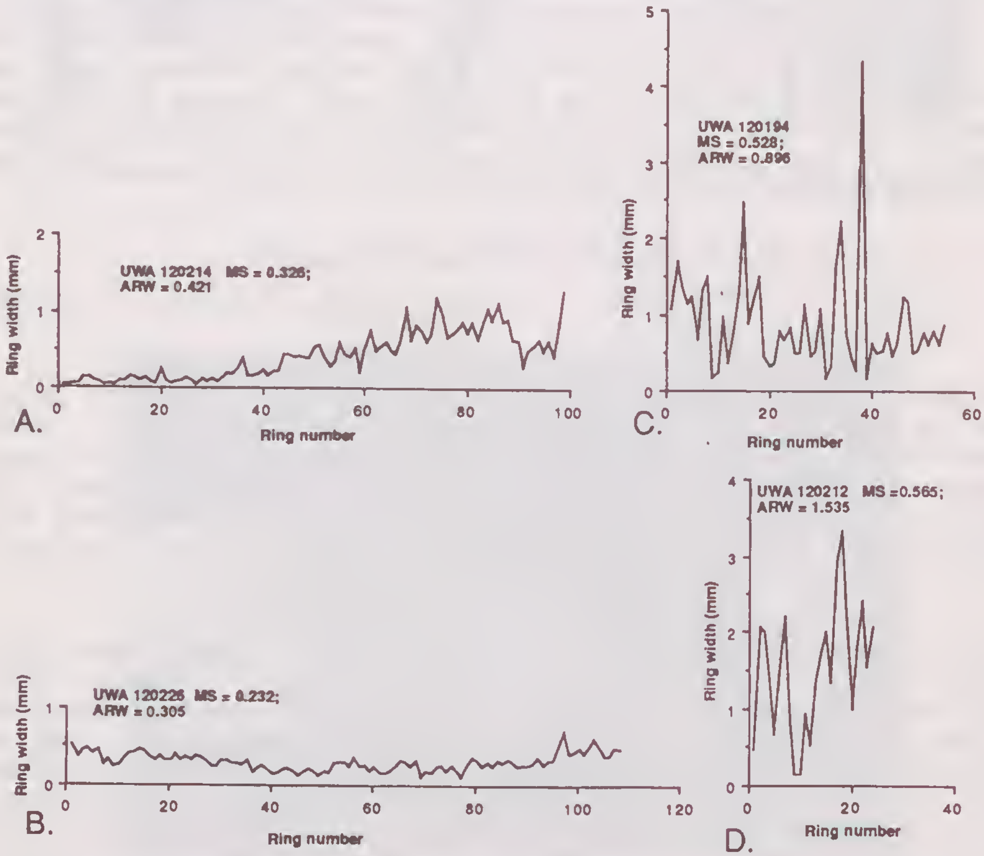

Fig. 5 Plots of the variation of growth ring widths for selected Western Australian Cretaceous woods. MS = mean sensitivity; ARW = average ring width in mm.

(Figs. 5C,D). Woods display mean sensitivities ranging from complacent to mildly sensitive (0.148 to 0.673) with the average mean sensitivity (0.348) falling within the "sensitive" field (Fig. 6B). False growth rings are produced in modern trees by adverse environmental conditions during the normal growth season. They show gradual reduction in cell diameters followed by gradual increases and differ from true growth rings which show abrupt transitions between the narrow thick-walled cells of the late wood and the broad thinwalled cells of the succeeding year's early wood. Although they are uncommon in the Western Australian woods, sporadic false growth rings are evident in some axes. Broad growth rings on some specimens may have in excess of 300 cells per band while others show as few as 10 cells per season.

Other assemblages of Early Cretaceous fossil wood from the Australia-Antarctica region (then a connected landmass) include those from the Otway and Gippsland Basins (Douglas & Williams, 1982), the Eromanga Basin (Frakes & Francis, 1990), the Carpentaria Basin (White, 1961), Alexander Island (Jefferson, 1983, 1987), and the Antarctic Peninsula (Francis, 1986). Early Cretaceous woods from all of these localities display marked seasonal banding as might be expected in high latitude floras. However, the presence of sporadic false growth rings in the Western Australian and Northern Territory woods (White, 1961) suggests growth within more erratic climatic conditions probably owing to their location within lower Cretaceous palaeolatitudes (Veevers et al., 1991).

The Carnarvon Basin woods have growth patterns falling between the complacent growth values shown by the narrow-ringed Eromanga Basin and Antarctic Peninsula woods which lack false growth rings (Francis, 1986; Frakes & Francis, 1990) and the sensitive or "erratic" growth parameters displayed by the Alexander Island woods (Jefferson, 1983) and Late Jurassic conifer woods associated with evaporitic sediments in southern England. The English Jurassic woods show erratic ring development comparable to wood growth in climatically variable 'Mediterranean' vegetation types (Francis, 1984). The Antarctic and Eromanga Basin woods have been compared to the modern Nothofagus and conifer forests of southern Chile, New Zealand, and Tasmania in terms of their growth ring patterns. The strong mean sensitivity variation of the Carnarvon Basin woods probably reflects their origin from a range of hinterland habitats. Taking into account the 45° - 50° palaeolatitude of the Carnarvon Basin, the sporadic presence of false growth rings, the range in growth ring widths, and the relatively high average mean sensitivity measure, a seasonal mesothermal

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

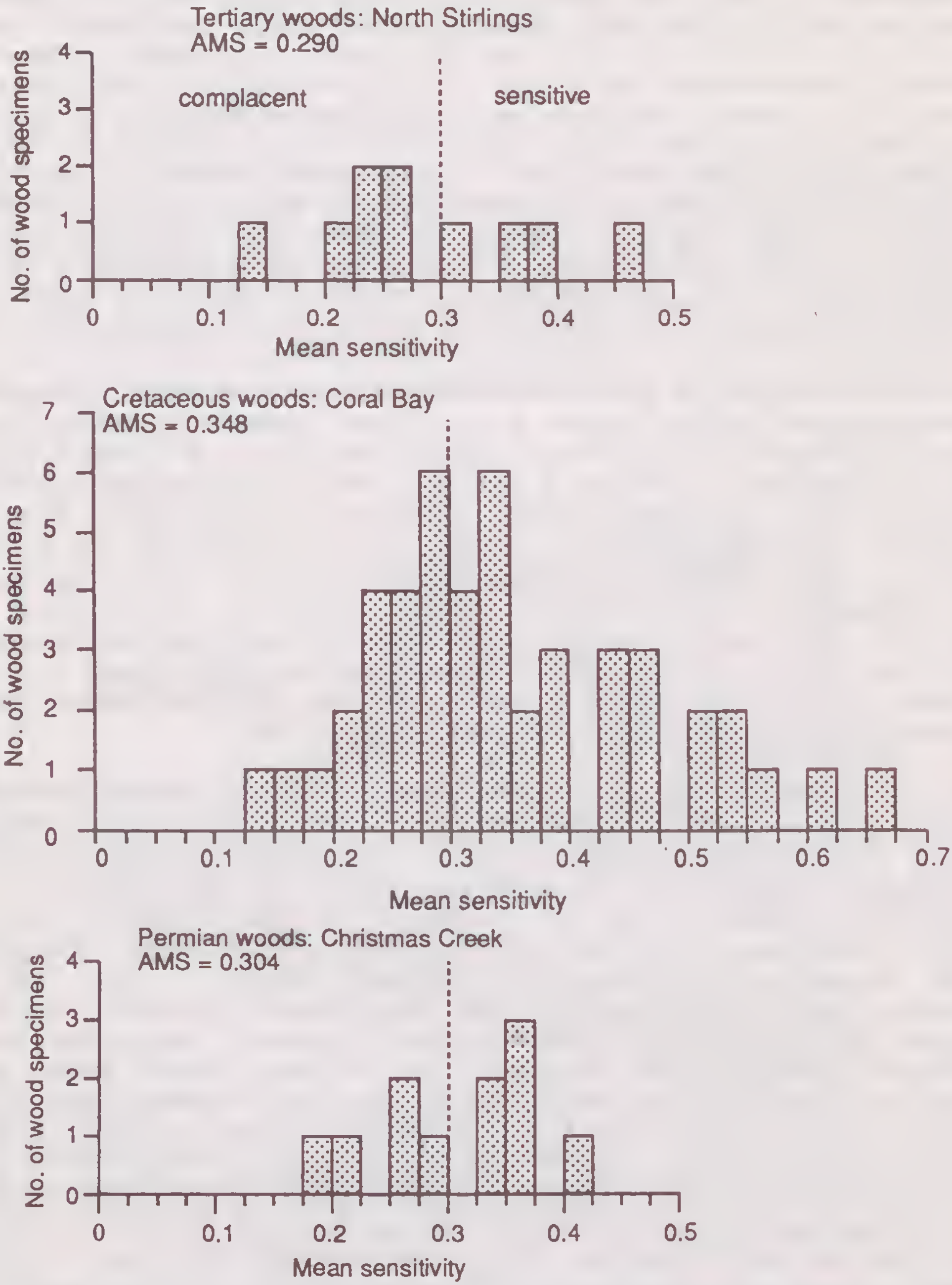

Fig. 6 Histogram of mean sensitivity values for 10 Western Australian Eocene, 48 Cretaceous and 11 Permian woods. AMS = average mean sensitivity.

conifer-dominated vegetation is envisaged for the basin hinterland during the Early Cretaceous. Climatic fluctuations may have been slightly more erratic here than in areas peripheral to the higher latitude Eromanga Basin. Further studies of the Western Australian, Gippsland, and Carpentaria Basin fossil woods would enhance our understanding of Australian Early Cretaceous climates.

Only small collections of Western Australian Permian and Eocene woods have yet been examined. These typically show less pronounced although often broader growth bands with lesser average mean sensitivities (Figs. 6A,C; 7). Although Australia was also at high latitudes during these times, year-round humid conditions may have reduced growth variability between seasons. Although Australia experienced glaciations in the Early Permian, the climate probably substantially ameliorated by the close of that period with wet mild temperature climates prevailing. The occurrence

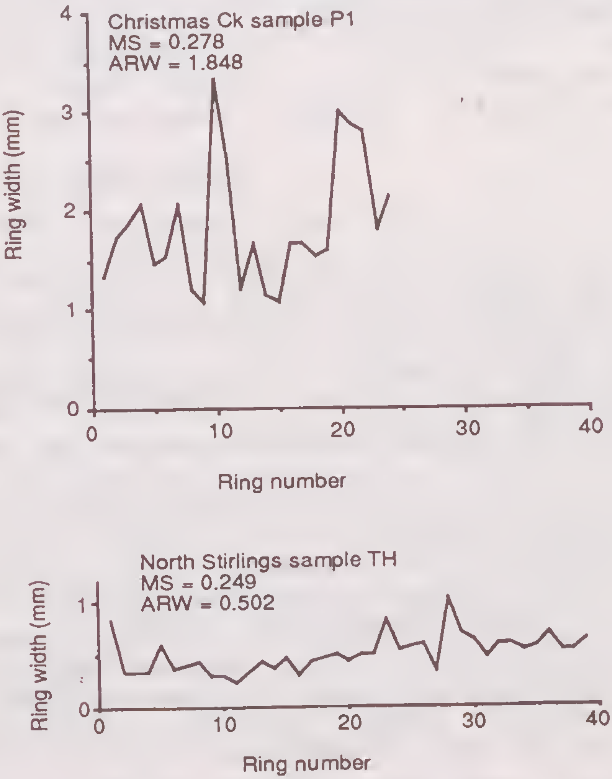

Fig. 7 Plots of the variation of growth ring widths for selected Western Australian Permian and Eocene woods.

PETRIFIED WOOD IN WESTERN AUSTRALIA (Cont.)

of several typical rainforest elements in angiosperm leaf assemblages in the southwest (McLoughlin & Guppy, 1993b) also favours a humid climate for the Eocene.

Conclusions

The process of wood petrifaction is much misunderstood in the general literature and largely involves impregnation, coating and infilling of cavities within the wood cells. As such it differs from cast preservation and is not a case of molecule by molecule substitution of organic material by minerals. Fossil woods from a range of geological periods (especially the Permian, Cretaceous and Eocene) offer potential insights into Australia's past climates via growth ring studies. Western Australian woods of these ages show features typical of seasonal humid climatic regimes no longer experienced in most parts of this state. The Cretaceous woods show somewhat more variable growth patterns than Permian or Eocene woods suggesting a more erratic climatic regime for that period. Additionally the Cretaceous woods preserve the remains of saprophytic fungi and marine bivalve borings which aid the interpretation of ancient ecosystems and depositional environments.

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MORE ON FOSSIL KING CRABS

John Pickett, Geological Survey of N.S.W., P.O. Box 76, Lidcombe, N.S.W. 2141.

Fossil king crabs have scored a number of mentions in **The Fossil Collector**. The first of these was a summary article by me (Pickett, 1985) outlining the Australian occurrences known up until that time (three of them, after a few rejections). The second was the announcement of the discovery of a fourth specimen, calling for contributions to a purchase fund, and nobly getting the fund off to a flying start with a donation of $150. Most recently, another summary article on fossil chelicerates (Selden, 1993), brought my earlier summary up to date, and indicated that an article on specimen number four was in press. That article has now appeared (Pickett, 1993), which means that I can use the name in print; this is significant, since it was named in honour of all the good people who contributed to the purchase fund. As the most generous contributor (apart, as must in fairness be said, from the N.S.W. Government, which covered contributions on a dollar-for-dollar basis) was The Fossil Collectors' Association of Australasia, this journal is an appropriate place to thank you all.

MORE ON FOSSIL KING CRABS (Cont.)

The specimen was recovered by a couple of men collecting flagstones at a roadside locality known as "The Dungeons", east of Parkes, N.S.W. They felt it might earn them a few quid, and so brought it to Alex Ritchie at the Australian Museum, who quickly recognised the specimen for what it was and immediately called me over to see it. The finders initially suggested a purchase price of $5,000; Alex and I managed to persuade them that $1,000 was more realistic, but we still needed to raise the money. After the initial donation from the F.C.A.A. I gave a lecture on king crabs past and present, under the auspices of the Australian Museum Society (I cannot claim that Sydneysiders thronged the hall; alas, invertebrate creatures do not capture the popular imagination the way their backboned cousins seem to do!), and that helped a bit; Sue Turner, whom I can recommend to anyone seeking a lively P.R. agent, passed the hat around at an A.A.P. meeting in Christchurch during December 1985; and there were individual donations. So, by degrees, we raised the money, and the specimen became the property of the Australian Museum.

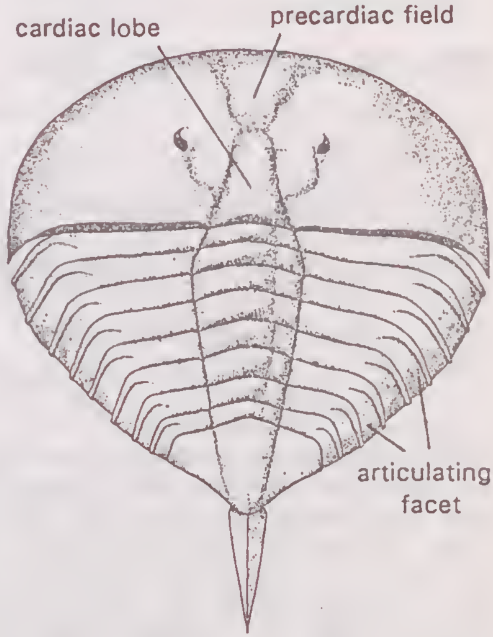

Fig. 1 (left). Kasibelinurus amicorum Pickett, 1993. Holotype, latex cast of dorsal counterpart, x 1.
Fig. 2 (right). Reconstruction of K. amicorum, by Roger Springthorpe, Australian Museum, Sydney. The telson (tail), lacking in the original, is hypothetical.

Having finally got the specimen into a situation where I could examine it in detail and begin to prepare it, my initial reaction was one of considerable disappointment. Whereas the Triassic species Dubbolimulus peetae, described earlier (Pickett, 1984), which is preserved in a fine, hard shale, showed many details, including most of the appendages, the new specimen occurs in sandstone, so that detail below the size of the sand grains is not preserved. Apart from that the specimen, which appears to be a moulted carapace, has suffered some pre-burial damage (no tail or appendages), the anteriormost right pleura has been lost, and the anterior left pleura has largely covered the head-shield (the prosoma). The initial examination indicated that, whereas the form was clearly new, its preservation was such that important details would be lacking from a formal description. Consequently the specimen was set aside for some time, during which the type locality was visited at every possible occasion, in the hope of turning up an additional specimen. No luck so far, however. Other fossils occurring at the locality are the lepidodendroid Leptophloeum australe and rather macerated plant remains, the best preserved of which are similar to the material from the Genoa River described by Dun (1897) as Archaeopteris howitti McCoy.

During 1992 a visit from Paul Selden of the University of Manchester encouraged me to renew work on the specimen, which has now been described as Kasibelinurus amicorum; the species name, from Latin amicus (= friend), is an expression of thanks to all of you who helped obtain it for a public institution. Whereas the Dubbo species, Dubbolimulus peetae, was named for its finder, Judy Peet, who graciously donated the holotype specimen, this is not the case with K. amicorum; its finders have had their reward.

The illustrations (Figs. 1, 2) show the holotype specimen at twice natural size, and a reconstruction of the entire animal by Roger Springthorpe, of the Australian Museum. Kasibelinurus has a feature not known in any of its relatives, the rather bulbous lobe on the

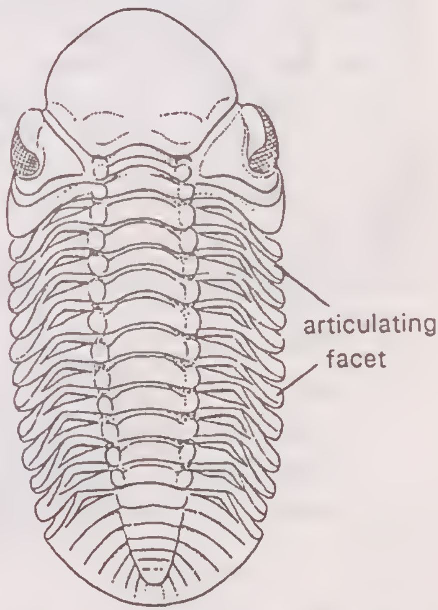

Fig. 3. Dorsal view of the phacopid trolobite Reedops sp., showing anterior position of the articulating facets.

MORE ON FOSSIL KING CRABS (Cont.)

prosoma in front of the eyes. The area behind this, known as the cardiac lobe, is present on most limulines (see for instance the two illustrated by Paul Selden in The Fossil Collector No.41, p.15), but it never reaches the front of the prosoma. This new structure has been termed the precardiac field. Why it should be there and what its implications are for the anatomy and behaviour of Kasibelinurus remain subjects that can only be guessed at. Other unusual features of the new genus are the straight eye-ridges and the quadrant-shaped raised areas behind them.

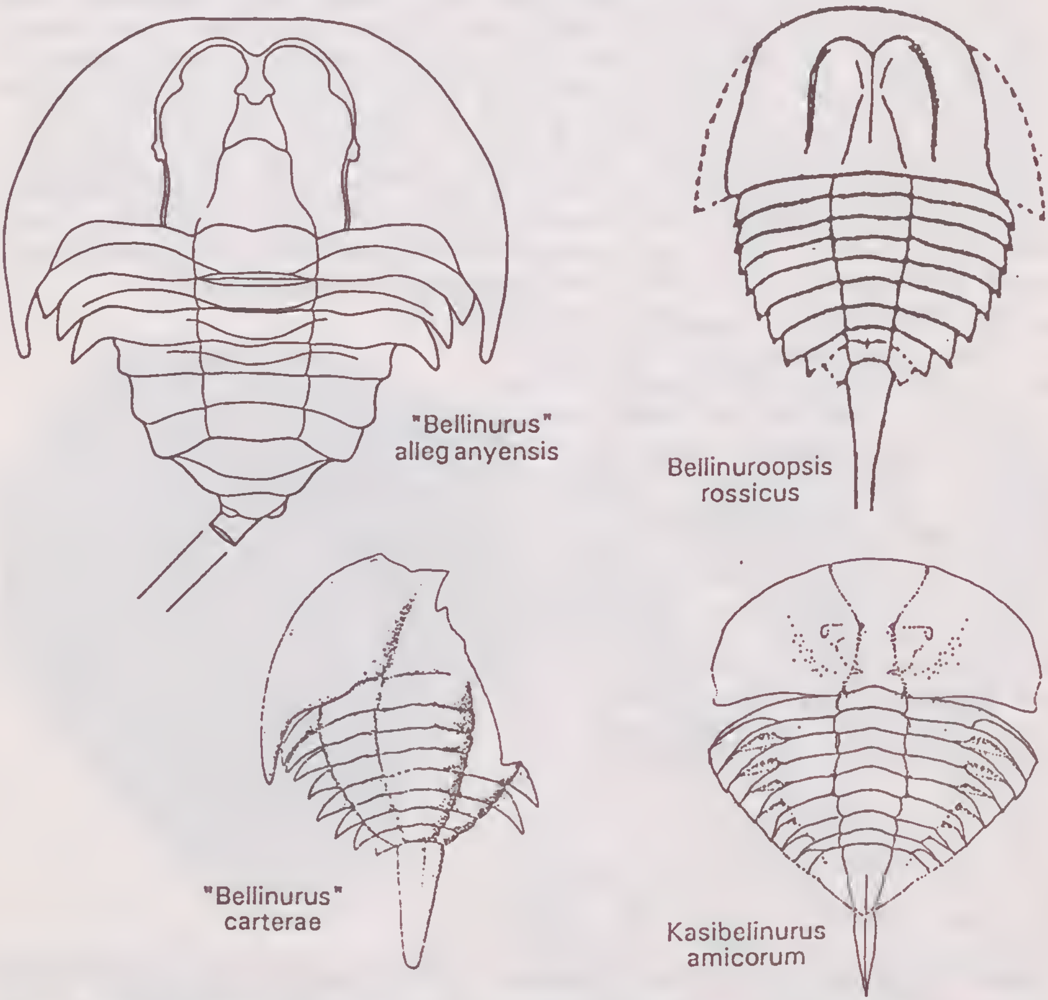

Fig. 4. Line drawings of the four Late Devonian limulines currently referred to the family Kasibelinuridae.

Kasibelinurus, Bellinurus in the broad sense, and Bellinuroopsis differ from most younger limulines in that the segments of the opisthosoma ("thorax") are separated, and not fused into a single inflexible shield, as in all modern limulines. This gives them a trilobite-like appearance. Most trilobites were capable of enrolling, and the structure of the pleurae of K. amicorum indicates that it too had this ability. However, there is significant difference. During enrolling the pleurae must slide over one another, because of the arching of the body in lateral profile. This results in the development of differentiated areas on the pleurae known as articulating facets. In trilobites these facets lie on the front of the pleurae (Fig. 3), while in Kasibelinurus they occur on the posterior margin.

Kasibelinurus is so different from other known limulines that it has been made the type of a new family, Kasibelinuridae, to which two Late Devonian species from eastern North America (Bellinurus carterae Eller and B. alleganyensis Eller) and a third from Russia (Bellinuroopsis rossicus Chernyshev) have tentatively been referred (Fig. 4). Published illustrations of these latter three species are lacking in much critical information, so their type material is currently being re-examined in order to achieve a better assessment of their relations to one another and to K. amicorum. At the very least, it is clear that the two North American species do not lie comfortably in the basically Carboniferous genus Bellinurus.

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OTOLITHS

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This is a further note on some of the smaller and unusual fossils, found in the washings from our fossil localities, which are often overlooked even though no special techniques are required for their recovery.

The Tertiary marine deposits in southern Australia have yielded very few articulated fish fossils. Long (1991) refers to specimens from the limestones along the Murray River at Morgan, which are at present undescribed, and to the head of a flathead from the Upper Oligocene at Wynyard, Tasmania described by Corbett (1980). This is probably because fish decompose quickly after death and many carcasses float to the surface and rapidly become disarticulated; those complete skeletons found coming from fishes which did not float after death and were probably quickly buried (Schaffer, 1972). However, we know that an extensive fish fauna existed in those times because of the presence of numerous otoliths or ear-stones. Only certain parts of the fish skeleton (otoliths, teeth, dermal bones, scales, vertebrae and spines) are strong enough to resist transport and abrasion and so be preserved. The most studied microscopic remains in Tertiary-Recent deposits are the otoliths and what are called ichthyoliths (microscopic fish skeletal debris - commonly teeth and scales). Anyone wanting more information on ichthyoliths is referred to Doyle and Riedel (1979) for a complete set of figures and list of references up to that time. Some minute (0.05-0.5 mm) planoconvex and ellipsoidal calcareous particles, termed ossiculiths (Frizzell and Exline, 1958) have been found as accessories in the auditory labyrinth of recent fishes and have been recorded from the Middle Eocene of Texas.

Otoliths are small (usually about 10 mm long), flatish, lemonpip-like in shape, calcium carbonate granules found in the inner ear of vertebrates. They are used to register the animal's position with respect to gravity. Similar organs are known in invertebrates e.g., cephalopods (Clarke et al., 1980) and crustacea (Steurbaut, 1989) and referred to as statoliths.

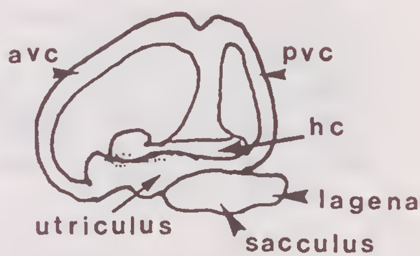

FIGURE 1. Diagram of fish membranous labyrinth; avc, anterior vertical canal; hc, horizontal canal; pvc, posterior vertical canal.

In fishes the ear is embedded in the otic bones of the skull where a

complex closed system of canals, called the membranous labyrinth, is found. There are three otoliths in each of the left and right side labyrinths. They are found in the sacculus - the sagitta, in the utriculus-thelapillus, and in the lagena - the astericus. The sagitta is usually the largest otolith and normally has a distinctive shape whilst the other two are much smaller and less distinctive - for example in the living Australian Salmon the sagitta is about 12 mm long and the other two only 2-3 mm in length. The shape, size and sculpture on the sagitta vary with different genera so it is possible in some cases to make generic identification with Recent fishes. During ontogenesis changes do occur although specific differences can be hard to pinpoint in closely related juveniles, normally however, the adults are readily distinguishable. Sex dimorphism is not apparently known to occur within otoliths but side dimorphism does occur with some flat fish. The carbonate is laid down in yearly layers which can be easily seen in sectioned specimens thus enabling the age of the fish to be determined and, with chemical analysis of the rings, the water details of the habitat. Details of habitat changes with age can also be found.

The main morphological terms associated with otoliths are shown in Fig.2.

Otoliths are not normally found as surface fossils although the larger specimens may be seen with a sharp eye. More commonly washing sediment through a nest of sieves and then checking the retained material will release any otoliths present. The depth of deposition of the rock type will influence greatly the probable number found - tidal, brackish and lagoonal deposits usually have

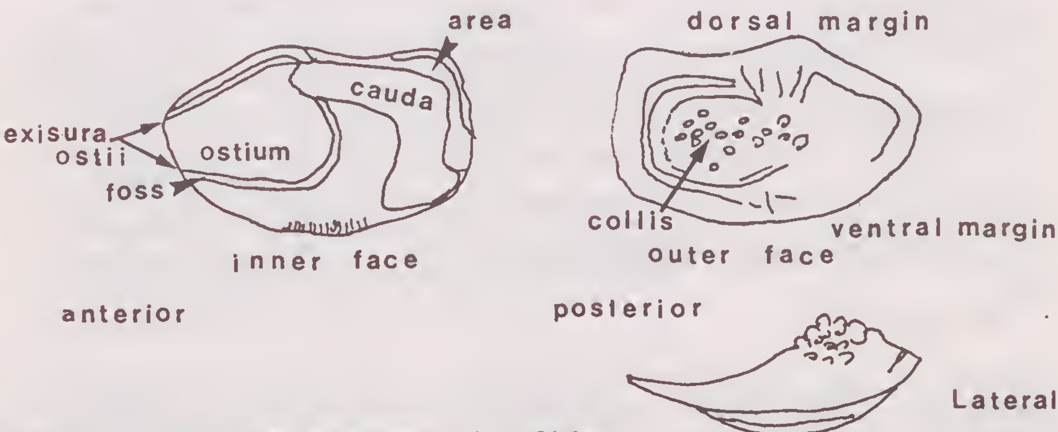

FIGURE 2. Morphological terms used with otoliths.

OTOLITHS (Cont.)

a sparse fauna, with number of species and specimens increasing with increasing depositional depth. The number of specimens to be found in a sample is highly variable; in New Zealand Schwarzhans (1984) found numbers from several to several thousands per cubic metre of unsieved material, with an average between 100 and several hundreds per cubic metre.

From the Victorian marine Tertiaries otoliths have been found from Palaeocene to Pliocene, with the majority coming from Miocene localities but this may just reflect collecting strategies over the years. Many of the otoliths indicate that the marine fish populations of those times were similar to that found today e.g., whiting, flathead, flounder, marine eels, snapper. The generic and specific identification of specimens is not easy due to the lack of work done on the faunas and to the fact that otoliths of recent fishes are seldom described, consequently anyone seriously interested in identifying the fossils is virtually obliged to make a collection of recent forms for oneself.

Papers actually describing the otolith fauna in Australian Tertiaries are uncommon:

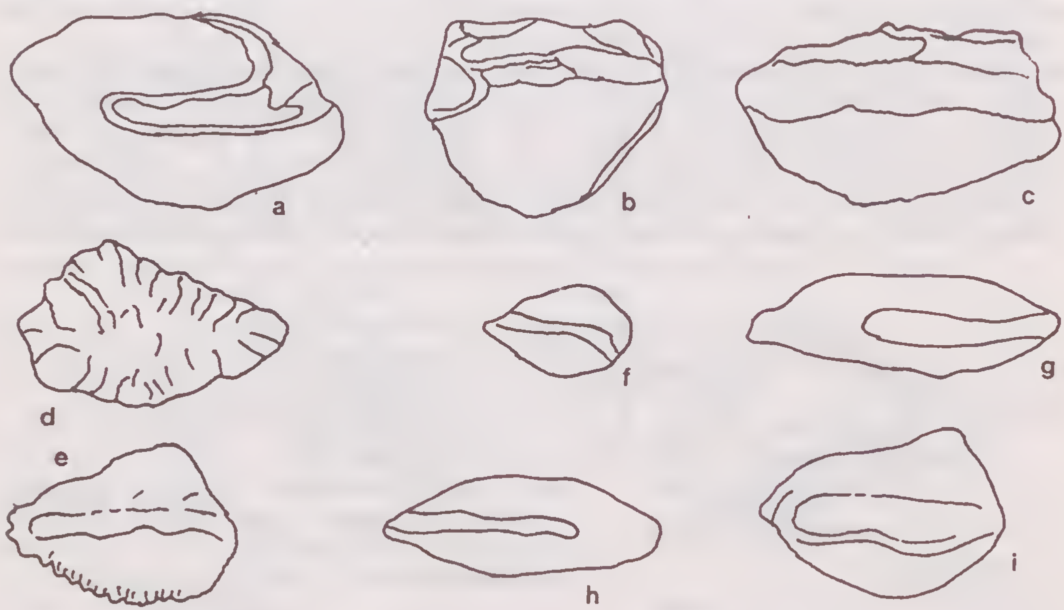

FIGURE 3. Examples of otoliths: a, Uroconger; b, Myripristis; c, Sillago; d, Coelorhynchus - outer face; e, Coelorhynchus - inner face; f, Percidarum; g, Astroconger; h, Platycephalus; i, Gadus.

Frost (1928) made the first study of some N. Z. and Victorian forms. Stinton (1952) described some from the Pliocene of South Australia, and the same author in 1958 and 1963 described some Victorian species. Long and Turner (1984) list all the Australian otolith species and their localities recorded at that time.

In New Zealand the fauna is much better recorded; Stinton (1956) described a small fauna and Schwarzhans (1984) made a detailed study of the fauna recording about 160 species and included diagrams of a number of Recent otoliths for comparison.

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FOSSIL HUNTING IN RUSSIA

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This story begins with me attending a symposium in Chiang Mai, Thailand, in February/ March, 1993, on the palaeontology and biostratigraphy of mainland southeast Asia. There I met the former head of the Geological Survey of a European country who told me with great enthusiasm about a fossil site he had visited in Russia "The richest I've ever seen - the entire formation was condensed down to just a few meters thick. Large, perfectly preserved ammonites were everywhere, and I couldn't walk around to look at them without stepping on ichthyosaur bones". Well, this was certainly intriguing, and from the horse's mouth, so to speak. Further, saying that his host when he had been there wanted contact with foreign fossil collectors, he gave me an address in Russia to write to.

After many months, letters, FAXes, telegrams, etc., I found myself in Prague on a last-minute two-day shopping trip with my friend Henry before we caught the train to Moscow.

On the train we met a group of Russian business people who introduced us to the friendly Russian custom of drinking large amounts of vodka. They put us up in their Moscow apartment, showed us around, fed us new and wonderful Russian foods, and helped us purchase train tickets to Ulianovsk, on the Volga - no easy task! Moscow has some lovely sights, but much of the city is bleak, ugly, muddy and depressing. Rainy too.

Arriving without a clue in Ulianovsk, the city where Russia manufactures it's jumbo jets, we were impressed by the fact that no one smiled. Henry said that maybe they had nothing to smile about. It was rainy, muddy and depressing. Old ladies in thick clothes were selling tomatoes, potatoes, apples, and sour orange berries along the path to a bring-your-own-wide-mouth-jar beer shop. The bread is wonderful.

We finally caught a crowded bus to Undori, having run out of other ideas. The Russians are expert at crowding onto buses, and we had to stand the whole way, luggage on our feet and other standing passengers propping us up.

Through blind luck we were able to locate the man who was to lead us around by the nose for the next ten days and, through a series of cunning manoeuvres, do us out of an unseemly amount of money. He took us to a mind-boggling warren of underground rooms, where hundreds, maybe thousands of large ammonites, mostly Speetoniceras versicolor, were stacked everywhere on dusty shelves, floor to low ceiling, interspersed with boxes of crumbling ichthyosaur and plesiosaur bones. Were we impressed! This is what we were here for!

He got us a room at an ancient spa that had seen much better days. Three very dirty days later we discovered there was a sauna and hot shower, and got all-over clean for the first time in a week. People seemed to come to the spa to spend quiet time (families with children), or to party wildly for a day or two. We generally spent more time with the latter, as they were active in the evenings when we returned from looking for fossils. They ate huge meals of fish stew, potatoes, Volga fish, rice, carrot and goat stew, smoked fish from Moscow (good!), all washed down with large quantities of vodka, of course. Twice we were invited to join them, and had a great time toasting international friendship, etc. One evening we heard an accordian, and singing, and went to investigate. We were caught up in a crowd of singing, dancing people and swept into their room for music and drinking. The only frightening aspect to this otherwise idyllic residential situation were the vile and treacherous unlighted long-drop toilets and the dangerous dogs belonging to the ex-

military survivalist son of the couple who ran the sauna. (One night he successfully demonstrated how to find edible mushrooms in the dark forest without using a light).

Interspersing this sporadic night life were dinners with our host and his family (more wonderful food, which later appeared on our bill), and a series of long futile days hunting fossils.

Our host hired a car and driver for us, who took us, our host and his three teenage sons, to various classic localities that we couldn't walk to. Once there, they would run like deer up the "beach", (the tree-and-rock-strewn bank of the Volga), leaving no stone unturned while we followed in the wake of their devastation, hoping to see something they'd missed.

After some days of this, we asked if there weren't some sites with fossils worth collecting. He said "No" - his awesome basement was apparently the distillation of twenty years of collecting these sites. Then he showed us the boat we paid to go out in (but never did). His crew, just returning from a collecting trip, loaded six or eight gorgeous large ammonites into our vehicle - "For the museum", he said. The incomplete specimens were kept by the men to be cut up for their lapidary business. We now began to see why we weren't finding much....

We told him we wanted to go to a site where we could collect something beautiful to take home with us, not just "study" specimens. He had the driver take us south and west of Ulianovsk, where we could dig <u>Craspedites nodiger</u> and <u>Yarniceras catenula</u>, small but good colour. Luckily Henry had borrowed some heavily padded pants and jackets from our ex-military survivalist, so we were claustrophobically warm in our mummy bags inside our reviled tube tent. At 2 a.m. our superiorly-equipped host, his son, and driver were all in the "jeep" with the motor running and the heater on. One of our support ropes was tied to the vehicle and I was afraid they'd drive away, with me unable to get out of my bag!

Next morning they abandoned us for two more nights with some food, their canvas tent, the "Russian runs", and not enough firewood or toilet paper. (We eventually cured ourselves with doses of eucalyptus oil taken with berry jam). We dragged firewood from far away and used up a lot of Russian newspaper.

When our host finally returned, we took down the tent in the rain and stuffed ourselves into the "jeep" for the ride back. We told him we'd had enough of seeing these classic fossil-less sites, and we wanted to leave as soon as possible, to go to Kazan to visit our friends there.

To make a long story short, we purchased three large pyrite encrusted <u>Speetoniceras</u> and two gorgeous <u>Ancyloceras simbirs</u> heteromorphs, packed all our specimens and junk into two huge 80 kilo. wooden crates, and paid our host to take us to the train station, where some mineral collectors from Moscow met us and gave me a pretty Cretaceous echinoid with pyrite crystals from Kafkaz. Then we just about wrecked ourselves (the first of too many times) running down flights of stairs, along platforms, and talking and wrestling our way onto railroad cars with two ridiculously heavy crates full of what was mostly junk. Soon we would start to ask ourselves if it was worth the effort.

Arriving in Kazan, we got our boxes out of the train and found we were trapped. No way could we carry those crates up those huge iron stairs, much less across the entire railroad yard and down the stairs at the other end. "Wait here", said Henry, and disappeared. He was gone for over two hours. It was getting dark, dangerous-looking people were walking by, and refugee children from the tents near the tracks were circling ever closer to our luggage. Luckily, the conductress from our old train car drove them away.

FOSSIL HUNTING IN RUSSIA (Cont.)

Henry finally arrived through a maze of tracks and mudholes with another Russian "jeep" into which we stuffed our crates and baggage. The driver and his friend put us up in an extra apartment and in the morning took us to Henry's friend, an engineer (an engineer makes $20 a month, while a waitress makes $65 - she "works"), who introduced us to some very kind people at the Kazan Museum who invited us to go on a Mammoth hunt.

With alacrity we accepted, and the next day went by train, bus, then the back of a huge muddy truck, over perhaps the worst road I've ever been on, to a remote village (all in the pouring rain, of course) where we all ate and drank the food and drinks we'd brought and slept in a room provided by the village.

In the morning the sun was shining over a sea of mud and pools of water. Geese were walking everywhere, and horses pulled rubbertyred carts through the places the large trucks and tractors weren't busy churning up.

We walked down to the lake where farmers had discovered a chunk of ivory while they were grading the access to the water, and proceeded to dig several ribs, chunks of ivory and a vertebra out of the sticky wet clay, to the great amusement of the crowd of assembled farmers, who helped us dig. This was Mammuthus primogenius, and it was a wonderful day!

From there we went to Moscow, visited the "Bird Market", and the wonderful Palaeontological Museum, where we donated some money for the electricity so we could spend hours looking over the wonderful displays.

Finally, we took the train back to Prague, somehow getting our crates across the Russian border without the necessary new forms that we hadn't been given by the Ulianovsk Museum. And in the nick of time - two weeks later, Yeltsin dissolved Parliament.

SOME CAMBRIAN FAUNAS OF NORTH-WEST QUEENSLAND

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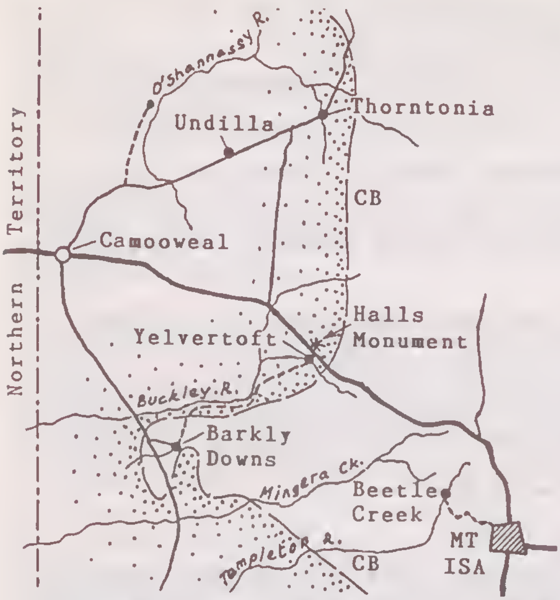
Introduction

Some of the Middle Cambrian units visited on one of AGES educational tours in north west Queensland are outlined. It is not intended to present a detailed account on the Georgina Basin faunas, rather to highlight some of the more accessible units visited on my tours, and to give an overview of their relationship to one another in the field and their stratigraphic relationship in a broader context.

Geology and Geography

The Georgina Basin comprises an elongated Lower Palaeozoic sedimentary province covering some 330,000 km^2 of northern Australia. It is bordered on the east and west by rocks of Precambrian age, in the south east it is overlapped by Cretaceous rocks of the Great Artesian Basin, and in the north west it merges with rocks of the Daly River Basin which are of a similar age but somewhat different lithostratigraphic content. The eastern part of the basin is divided into five major areas: the Ardmore, Mt. Isa and Burke River Outliers in the south, and Lady Annie/Lady Jane Outlier and Undilla area in the north.

In early middle Cambrian time a marine transgression rapidly invaded the area, and a



LOCALITY MAP - broken line marks approx. eastern boundary of Cambrian outcrop in the Georgina Basin.

carbonate-evaporite-terrigenous sequence of complex facies interchange was deposited over most of the basin. This sequence is assigned to the Ordian Stage and is conformably overlain by the Templetonian Stage, a sequence consisting predominantly of shales and siltstones in the south and more carbonate facies in the north. Considerable diagenetic changes have taken place in these sequences including silicification, evaporite dissolution, dolomitisation and dedolomitisation.

Outcrop is generally poor due to the low angle dip. The more clastic sediments of the southern areas of the Georgina Basin are more steeply dipping in the vicinity of northern and western boundary fault systems, but even here outcrops are generally restricted to a few metres.

In the northern (Undilla) area due to the resistant nature of the low dipping carbonates some tens of metres of sediment may be exposed on this pediment topography over a distance of a kilometre or so. Other exposures are limited to creek beds and the occasional mesa scarps of highly silicified clastic-terrigenous sediments. (Henderson and Southgate, 1978).

Fauna

The fauna is essentially Acado-Baltic* with most of the Scandinavian agnostid zones, represented by the nominate zone species starting with Ptychagnostus gibbus through to Leiopyge laevigata in the Middle Cambrian, followed by the polymerid and agnostid zones, Cedaria-Olenus and Glyptagnostus in the Upper Cambrian, (Opik,1957).

Mount Isa Outlier

The earliest Middle Cambrian unit containing trilobites occurs in this area at Hall's Memorial on the Barkley Highway. Here a siliceous rubble occurs on the surface with fragmentary remains; Redlichia idonea, and Redlichia chinensis are the dominant species. This unit is equivalent to the Thorntonia Limestone (visited in the Undilla area) and is of Ordian age (earliest Middle Cambrian), and has been referred to as the Yelvertoft Bed (David, 1932).

The Templetonian Stage following the Ordian, is represented by the Beetle Creek Formation, which outcrops in creek beds and as low pediments. The type section for the Beetle Creek Fm., occurs near "May Downs" Station, and is visited frequently by collectors. A somewhat better and less frequently visited outcrop occurs near Gidya Bore, where our tour stops.

Here white, leached shale and siltstone with minor chert interbeds occur on pediments

* Acado-Baltic - faunal term derived from 'Acadian', a name proposed by Walcott in 1891 for Middle Cambrian strata in eastern North America characterized by Paradoxides etc, (Harland et al., 1982) and 'Baltic', a name used for similar strata in Scandinavia where Westergaard and others divided this epoch into essentially agnostid zones (Opik, 1979).

SOME CAMBRIAN FAUNAS OF NORTH-WEST QUEENSLAND (Cont.)

which are profusely fossiliferous. Xystridura templetonensis is the most abundant trilobite with Xystridura milesi, Pagetia significans, Peronopsis normata and Lyriaspis. Slabs of shale are easily excavated, splitting on the bedding planes revealing an assortment of dissarticulated trilobite fragments and whole specimens.

The Beetle Creek Formation near Gidya Bore passes without a break into the overlaying Inca Creek Formation which is preserved as rubble on nearby hills. Lithologically it is indistinguishable from the underlaying Beetle Creek Fm., however, the boundary is marked by the absence of polymerid trilobites and the occurrence of the agnostid trilobite, Ptychagnostus atavus.

At Yelvertoft, north of the Barkley Highway and west of Mount Isa, the Inca Formation is represented by siliceous shale and siltstone. Outcrop is poor, restricted to small gullies and creeks where the black soil of the plains has been removed by erosion. As here the Inca Formation has a low angle of dip, it is necessary to cover a lot of ground in order to find exposures representing different stratigraphic horizons. The Inca Formation falls within the zone of Ptychagnostus atavus which is by far the most abundant agnostid. They are often accompanied by sponge spicules (Pleodioria) which are common in the more cherty layers.

The Undilla area

The Undilla area, north of the Barkley Highway has much more to offer by way of continuous sedimentation and facies interchange. In the north east, in the Thorntonia area, both the Ordian Stage (Thorntonia Limestone) and the Templetonian Stage (Beetle Creek Formation) are represented.

The Thorntonia Limestone has been highly dolomitised and fossils are restricted to lenses and nodules of chert. Although uncommon the fossils have enabled correlation with other parts of the Georgina Basin. Redlichia from the lower part of the formation has enabled correlation with equivalent stages in Southeast Asia, Scando-Baltic and North American provinces, and the indigenous, Xystridura in the upper part indicates that it is equivalent to the Beetle Creek Formation in the southern areas.

The Beetle Creek Formation which overlays the older unit with a slight disconformity, contains pelletal phosphorite, and is equivalent to the Monastery Creek Phosphorite Member, present in the Burke River Outlier. The mauve mineral Wavellite, an alumino-phosphate, is present in small amounts, replacing some brachiopod valves.

Fossils are locally abundant and in some places grainstone coquinas occur. The agnostids are predominant and include, Hypagnostus, Diplagnostus and the zonal index Ptychagnostus atavus. Brachiopods, (Linnarssonia, Orbithele, Micromitra), are also abundant, sponge spicules in the cherty layers and the hyolithid, Biconulites, seen in great profusion on some, weathered surfaces.

The Currant Bush Limestone, V-Creek Limestone and Mail Change Limestone occur further to the west and overlap the previous formations. They consist of flaggy, impure limestones and occasional mudstone interbeds. The Currant Bush Limestone probably represents an alternating subtidal, intertidal and supratidal environment. Algal mat is present, and some horizons are bituminous. Fossils are scarce and restricted to a few horizons containing agnostids.

The V-Creek Limestone is lithologically similar to the underlaying Currant Bush Limestone. Fossils are locally abundant and include the polymerid trilobites Asthenopsis and Papyriaspis, the agnostids Hypagnostus, Doryagnostus and Ptychagnostus and several taxa of primitive brachiopods, including Linnarssonia and Lingulella.

The Mail Change Limestone occurs near New Bore, just west of Undilla. Trilobites are scarce, but brachiopods more abundant, including Lingulella, Orbithele and Micromitra.

Burke River Outlier

In this area where the Thorntonia Limestone, Beetle Creek Formation and Inca Formation occur, there is a hiatus in deposition, the unconformity excluding the Currant Bush, V-Creek and Mail Change Limestones or their equivalents. Sedimentation commences again with the Roaring Siltstone, but at a later stage than the units examined in the previous areas. Fossils are locally abundant and include Ptychagnostus cassis.

The Devoncourt Limestone is extensive in outcrop in this area. Many outcrops are unfossiliferous but specific horizons occur where fossils are quite numerous.

Agnostids are generally scarce, the faunas being dominated by the polymerids; Proampryx agra occurs in profusion on some bedding planes and some fine specimens of Centropleura phoenix may be found associated with other faunas.

Concluding Comments

The various units examined on the tour, in the Mount Isa area, Undilla area and Burke River area, have been selected in order to present a broad overview of the sedimentary and faunal relationships of the Middle Cambrian in the eastern part of the Georgina Basin, and their subsequent relationship to Middle Cambrian rocks world-wide.

There is much that we do not get to see, time constraints and logistics impose limits, in fact there are many well documented exposures of Middle Cambrian, Upper Cambrian and Ordovician rocks that I have yet to visit, and on each trip it will be my intention to locate one or more of these units to expand my local knowledge.

Needless to say there are many things to see and do on the tour, the Pre-Cambrian rocks, hosting world class mineral deposits are worthy of close scrutiny, as are the wonderful Aboriginal art sites of the district.

If you are interested in being a participant on one of these tours, call or write for more information (see advertisement, this issue). I look forward to meeting some of you in the near future.

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IN THE NEWS

MONSTERS FROM THE DEEP REVEAL AN ANCIENT ERA

Bones from two extinct sea monsters, pliosaurs, have been uncovered on a fossil shoreline near Carnarvon, Western Australia, in what palaeontologists say might prove to be one of Australia's richest sites from the dinosaur era.

Spectacular specimens of fossil wood with tree-rings describing the ancient climate 125 million years ago, thousands of extinct squid-like animals and what is thought to be the first fossilised pliosaur droppings ever found make up the discovery.

The two pliosaurs, rare shortnecked paddle-finned predatory reptiles, were found a few hundred metres apart in the Cretaceous Birdrong Sandstone by Dr. Stephen McLoughlin and Dr David Haig of the University of Western Australia's geology department and Mr. Glynn Ellis of Lausanne University in Switzerland.

The animals, represented by a handful of disarticulated limb bones and vertebrae, appear to have been significantly larger than similar pliosaur finds from Lightning Ridge, N.S.W., such as the famous opalised fossil "Eric" and were between 3m. and 4m. long. Their discovery follows the find last year of a long-necked plesiosaur from Kalbarri.

In the last five years bits of half a dozen pliosaurs, ichthyosaurs, mosasaurs and plesiosaurs have been found. Dr. McLoughlin stated that palaeontologists had been alerted to the potential of the Carnarvon site by a local pastoralist who had noticed specimens of petrified wood on his property. These proved to be ancient podocarpus conifers, dating from a time when Australia lay close to the South Pole and was much colder, wetter and more seasonal with marked fluctuations in rainfall. At this time Gippsland lay less than 2,000km. from the pole itself and Western Australia formed the northern coastline of the continent.

One of the most remarkable discoveries was a lump of blackish rock thought to be a coprolite (fossilised piece of dung). Close inspection showed it to contain tiny fish bones, vertebrae, scales and teeth, indicating that it came from a fish-eating animal, most probably a pliosaur. This provided a clearer insight into what they ate and how they lived.

Together the fossils contribute to a picture of cool shallow seas richly inhabited by millions of squid-like belemnites and ammonites preyed on by voracious pliosaurs and other flesh-eaters. The seas were carpeted in a fine ooze, low in oxygen and ideal for preserving dead animals that sank into it. Floating tree logs from the land were rapidly attacked by sea-worms, indicating the water was saline.

All of the finds were made within a few hours during an initial survey of the area, indicating that it was likely to be incredibly rich in fossil specimens. This might make it possible to reconstruct the whole sea-edge ecosystem from 125 million years ago.

In a further important discovery, Mr. T. Cruse and Dr. Lyall Harris of the university's geology department have also reported the first Ediacaran fossils from Western Australia. These are among the most ancient forms of multicellular life on earth, dating from 600 to 550 million years ago and were first identified from rocks at Ediacara in the Flinders Ranges, South Australia.

Report by science and technology writer Julian Cribb in the **Weekend Australian**, October 2/3, 1993.

FATAL FLAW FINGERS FAKE FOSSIL FLY

A fossil fly that has been one of London's Natural History Museum's greatest entomological treasures for 70 years, is a Victorian fake. In a piece of detection worthy of Sherlock Holmes, Andrew Ross, a student of ancient insects, has uncovered an entomological crime on a par with the Piltdown hoax - but perpetrated at least sixty years earlier.

The unique and almost perfect specimen of Fannia scalaris - the latrine fly - is preserved in amber and was thought to have originated from the Baltic region some 38 million years ago. Hidden among the other 2,500 amber specimens in the museum's collections, the forgery has lain undetected for more than 140 years.

Throughout this time F. scalaris has acquired considerable scientific fame, not only as the oldest known representative of the housefly family, the Muscidae, but as an important example of a species that has survived unchanged for many millions of years. Now, thanks to Ross's astute detective work, the fly's undeserved fame is likely to be overtaken by a better deserved notoriety. "Fly specialists are actually pleased it's a fake because the fly is too advanced to have been around that long ago," says Ross.

Ross' revelation came as he was hunched over his microscope, working through the Natural History Museum's collection of 12,500 fossil insects. As he focussed on the latrine fly two cracks appeared on either side of it. Ross quickly removed the specimen from the heat of the lamp, fearing that it might damage the fly and destroy some vital anatomical detail.

Turning the amber piece around to check the extent of the damage, Ross noticed a faint but clear line running through the amber. And, curiously, the specimen seemed to be sitting in a hemispherical depression. The line and the hollow could be seen clearly from both sides. The implication was immediately obvious. This was a classic example of a doublet, a technique perfected by jewellers over centuries to "stretch" precious stones.

A genuine piece of Baltic amber had been carefully cut in half and a small grave-like excavation made in one surface. The fly was "interred" and the cavity filled with an amber-like resinous mounting medium. The two pieces were then glued together to form the doublet and the fake was ready to be launched on its remarkably successful scientific career.

No one knows the origin of the fake fossil but the specimen was first mentioned in 1850 in a published list of the collections of H. H. Loew, a German expert on flies. In 1922, the Natural History Museum bought 300 of Loew's amber specimens, including the latrine fly.

Then, in 1966, the world-famous entomologist Willi Hennig made the first detailed study of the specimen, and firmly established its scientific reputation as a kind of 'Peter Pan' of the fly family, clearly identifiable and unchanged by evolution for almost 4 million years - but with no known forebears or descendants until the present time.

The forger's identity is still a mystery, but the motive was probably simply money. In Victorian times, collectors like Loew paid good prices for interesting specimens and there was a lucrative market for fakes. The forger is unlikely to have chosen the fly deliberately to confuse future students of palaeoentomology. It was probably the nearest insect to hand.

Part of a report by Douglas Palmer in **New Scientist**, 13th November, 1993.

THE SOOM SHALE: A UNIQUE ORDOVICIAN KONSERVAT-LAGERSTATTE FROM SOUTH AFRICA

Preservation of soft tissues in the fossil record is rare and occurrences are concentrated at particular stratigraphic levels and in a restricted range of sedimentary environments. Cambrian finds are now widespread, but there is a dearth of similar records from the Ordovician. This gap in our knowledge can now be filled by a recently discovered fossil biota from the late Ordovician of the Cape Province, South Africa.

The fossils come from the Soom Shale Member of the Cedarberg Formation, which outcrops widely in the mountains north of Cape Town. Exposures of the shale are rare owing to its recessive nature, but two localities have produced exceptionally preserved fossils. The Soom Shale first gained attention through the discovery of giant conodont assemblages, which have subsequently been found with associated soft tissues of the conodont animals. More recent collecting has yielded eurypterids with appendages, muscles, respiratory and feeding structures preserved, together with other arthropods and enigmatic soft-bodied specimens. The fauna also includes brachiopods, trilobites and orthocone nautiloids; many of the bedding planes are covered by algal swirls, and palynomorphs have been recovered.

The Soom Shale is a black, finely laminated unit, conformably overlying tillites of the Pakhuis Formation. The laminae probably represent seasonal sedimentary episodes, with the fauna indicating open marine connections. As well as providing the first "Burgess-Shale type" Lagerstatte from the Ordovician, the Soom Shale presents a unique example of soft-tissue preservation in a Palaeozoic glacio-marine environment.

Richard J. Aldridge, Sarah E. Gabbott (Leicester) and Johannes N. Theron (Geological Survey of South Africa). Palaeontological Association Christmas Meeting abstract, from Palaeontology Newsletter 20, Autumn 1993.

BOOKS AND BOOK REVIEWS

LOWER DEVONIAN PELECYPODA FROM SOUTHEASTERN AUSTRALIA by Paul A. Johnston (Memoir 14 of the Association of Australasian Palaeontologists). Published by the A. A. P., Brisbane, 1993, 134pp.
[ISBN 0949466-13-1, ISSN 0810-8889]
Price AUS$30.00 (within Australia), AUS$40.00 (overseas).

Diverse, well-preserved fossil pelecypods representing 27 genera and 39 species are described from the Lower Devonian Limestones of New South Wales and Victoria. Taxonomic affinities are with the Old World Faunal Realm, although one genus Glyptodesma is of Eastern American aspect.

PALAEONTOLOGICAL STUDIES IN HONOUR OF KEN CAMPBELL edited by P. A. Jell (Memoir 15 of the Association of Australasian Palaeontologists). Published by the A. A. P., Brisbane, 1993, 459pp.
[ISBN 0949466-14-X, ISSN 0810-8889]
Price AUS$45.00 (within Australia), AUS$55.00 (overseas).

This memoir contains the Proceedings of a meeting of the A.A.P., held at the Australian National University, Canberra, 8 - 10 February, 1993. The Memoir includes papers on a wide range of palaeontological topics, including brachiopods, chitenozoans, cladism, cnidaria, conodonts, crinoids, foraminifers, graptolites, lungfishes, metazoan evolution, microvertebrates, osteolepid fishes, sedimentology, Cretaceous squid, stromatoporoids, trilobites, macropods, and a Devonian xiphosuran.

Copies of the above two Memoirs can be purchased from Dr P. A. Jell, C/o. Queensland Museum, P.O. Box 3300, South Brisbane, Queensland, 4101.

THE COLLECTORS GUIDE TO FOSSIL SHARKS AND RAYS FROM THE CRETACEOUS OF TEXAS by Bruce J. Welton and Roger F. Farish, 220pp.
(other publication details not available)
Price outside the U.S.A. - US$28.20 incl. shipping and handling.

Identifies over 80 species and contains more than 150 illustrations, most of which are photographs. Includes sections on Texas Cretaceous geology; tooth terminology (extensive glossary); ichnology (shark trace fossils); classification and taxonomy; how, when and where to collect; biology of shark and ray teeth, scales, spines and vertebrae; and preparation, storage and display. [Information from handbill]

Available from 'Before Time', 5 Remington Drive, Lewisville, Texas 75067, U.S.A.

FOSSILS OF THE SANTANA AND CRATO FORMATIONS, BRAZIL by David M. Martill (Palaeontological Association Field Guide to Fossils 5). Published by the Palaeontological Association, London, 1993, 159pp.
[ISBN 0-901702-46-3]
Price UK£11.50 or US$23.00 including post. & pack.

The author's preface notes that it is the primary aim of this field guide to provide information on sedimentary geology, palaeontology and palaeoecology of the Chapada do Araripe region of north-east Brazil for anyone wishing to undertake a short visit to the area and also to explain to collectors, who have obtained Araripe fossils from commercial dealers in the past, the circumstances in which these remarkable fossils occur. Of particular interest is the chapter on the fish fauna of the Santana Formation concretions, large numbers of which have been sold in this country. As well as black and white photographs of twelve of these fish, there is a six page key (illustrated with numerous line drawings) for the rapid identification of fish genera from the Romualdo Member concretions. Comprehensive flora and fauna lists of the fossils from the Late Jurassic - Middle Cretaceous (Cenomanian) Araripe Basin, Crato and Santana Formations, are contained in Appendices 1 & 2.

In addition to separate chapters on the structure, stratigraphy, and fish fauna mentioned above, the guide includes chapters on the Palaeontology of the two main formations illustrating the wide variety of fossil material discovered to date. Of considerable interest are details of the exceptionally well preserved insect fauna (Grimaldi, 1990) from the Crato Formation. This fauna includes representatives of the orders Coleoptera, Hymenoptera, Diptera, Orthoptera, Neuroptera, Odonata and others. Also recorded from this formation are scorpions, spiders, very rare decapod crustaceans, a bird feather and a frog. Among the diverse flora recorded are gymnosperms, angiosperms and possible gnetaleans.

Apart from the fossil fish, of which most of us are aware, the Santana Formation contains, in some concretions, considerable plant material. However, what is perhaps the most remarkable aspect of these latter deposits are the exceptionally

FOSSILS OF THE SANTANA AND CRATO FORMATION, BRAZIL (Cont.)

well-preserved pterosaur remains consisting mainly of large forms with estimated wing spans of up to five metres.

The book also includes very detailed field itineraries, a comprehensive bibliography, and appendices giving useful addresses and references to maps. Unfortunately for those of you who want to be on the next plane to Brazil, since the Field Guide was published, Brazilian law has been changed to make it illegal to collect, trade or export fossils from this valuable palaeontological resource. Previously it was only illegal to export fossils from Brazil without a permit.

Nevertheless this is a welcome addition to the general literature on the world's unique fossil deposits and should be of interest to both professional palaeontologists and amateur collectors who wish to broaden their knowledge without having to consult innumerable scientific papers [even the reviewer noted the mention of irregular echinoids being recorded in the Santana Formation (p.72)!].

Copies can be purchased from Dr Lesley Cherns (Palaeontological Association Marketing), Department of Geology, University of Wales College Cardiff, Box 914, Cardiff CF1 3YE, United Kingdom.

Frank Holmes